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(54) Expert system for diagnosing machines.

(57) An expert system which uses generic rules and which acquires its rule information from a physically separate relational database (i.e. is data driven). The expert system software architecture is modular which allows for different relational database files (i.e. new knowledge) to be utilized, thus allowing the software to be quickly ported to new applications. The expert system is particularly adapted for use as a machine (eg. stamping press) diagnostic, thus reducing press down-time. The reusability of the expert system, through new relational database files, quickly supports new diagnostic applications.

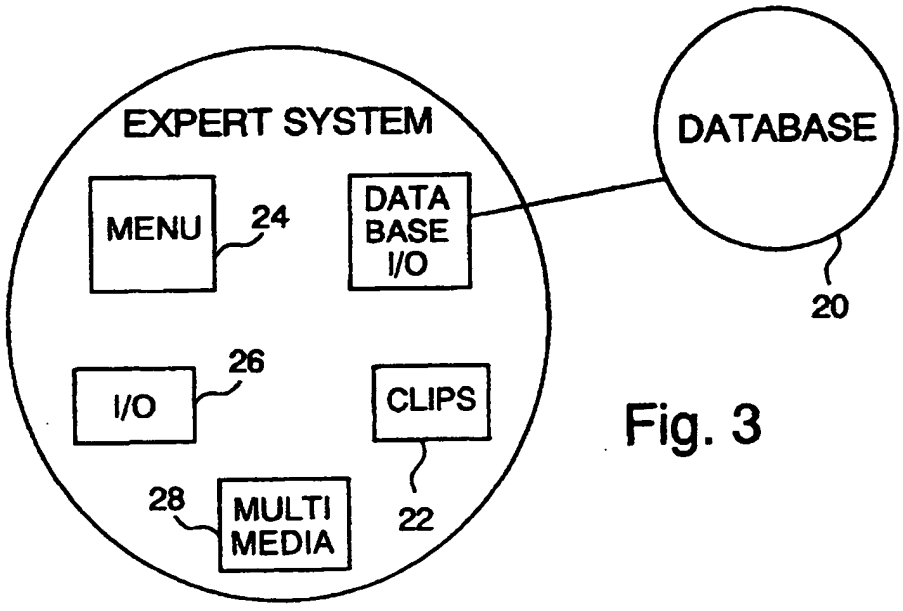

Fig. 3

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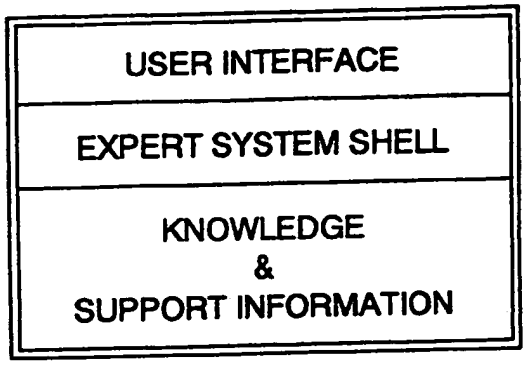

Fig. 1 (Prior Art)

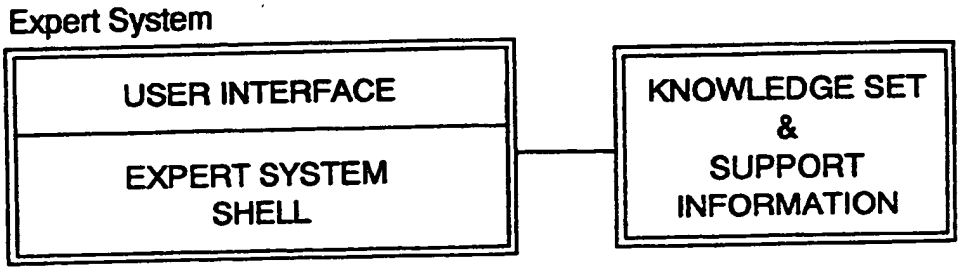

Fig. 2

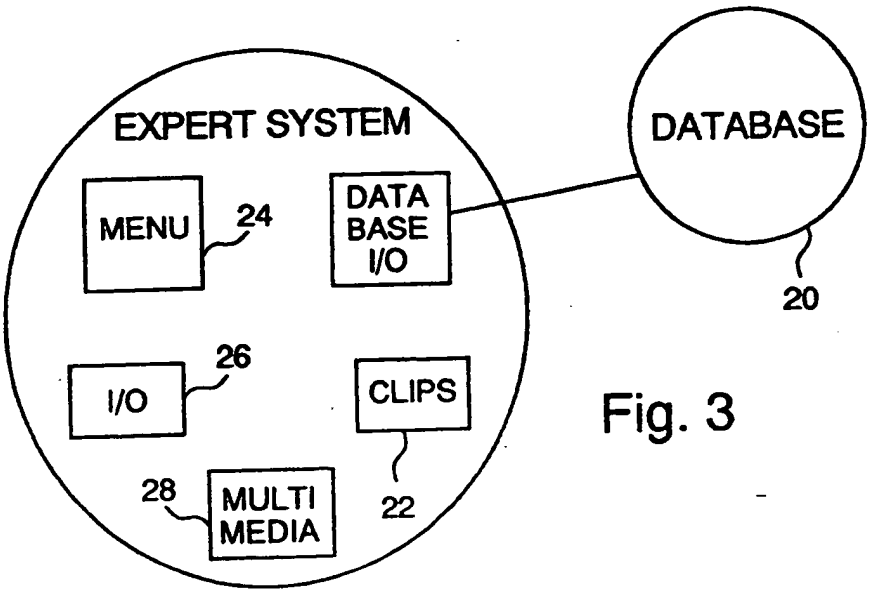

Fig. 3

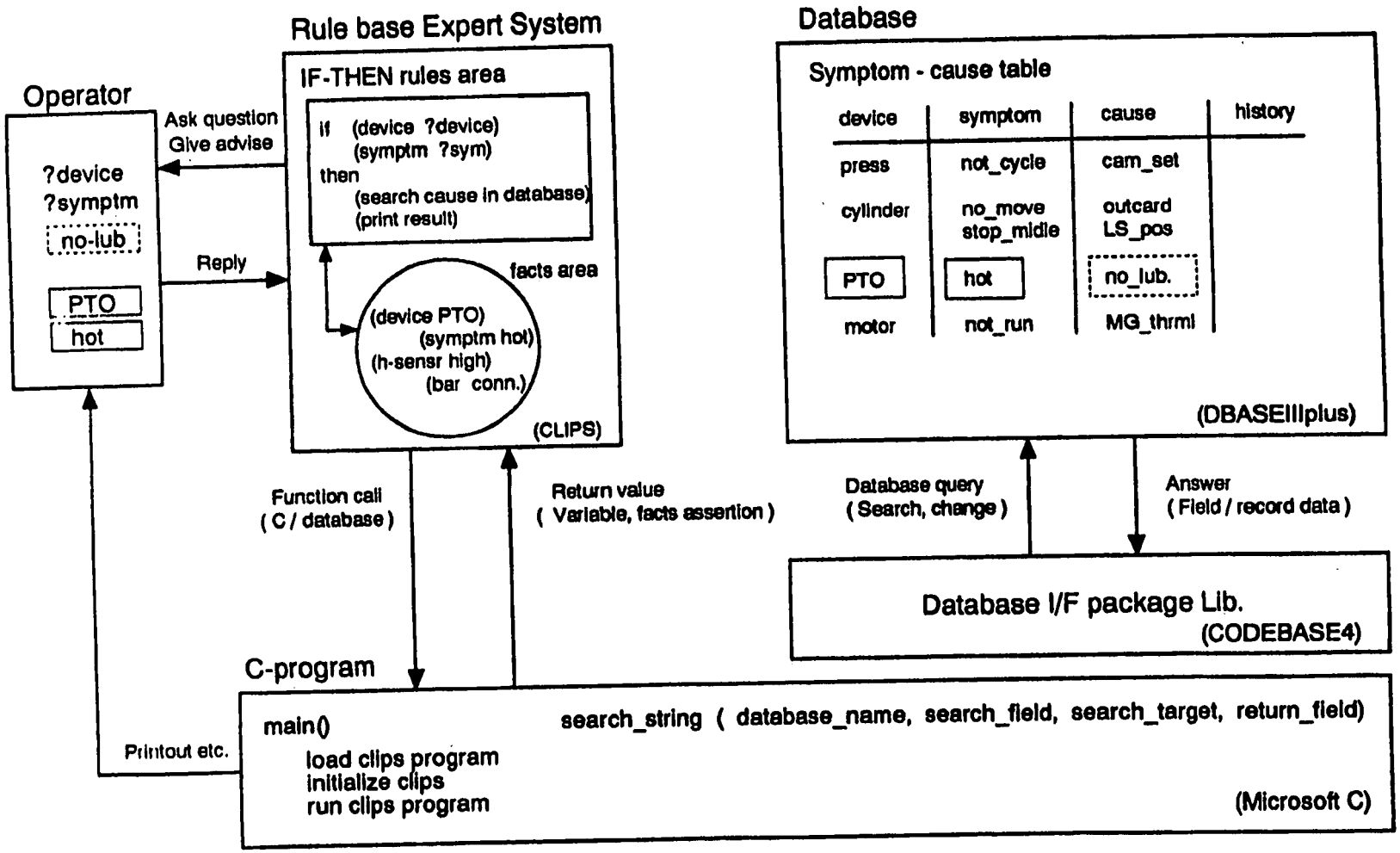
Rule base Expert System
IF-THEN rules area
if (device ?device)
(symptm ?sym)
then
(search cause in database)
(print result)
facts area
(device PTO)
(symptm hot)
(h-sensr high)
(bar conn.)
(CLIPS)
Operator
?device
?symptm
no-lub
PTO
hot
Ask question
Give advise
Reply
Database
Symptom - cause table
device
symptom
cause
history
press
not_cycle
cam_set
cylinder
no_move
stop_midle
outcard
LS_pos
PTO
hot
no_lub.
motor
not_run
MG_thrml
(DBASEIIIplus)
Function call
(C / database)
Return value
(Variable, facts assertion)
Database query
(Search, change)
Answer
(Field / record data)
Database I/F package Lib.
(CODEBASE4)
C-program
main()
load clips program
initialize clips
run clips program
search_string (database_name, search_field, search_target, return_field)
(Microsoft C)
Printout etc.

Fig. 4

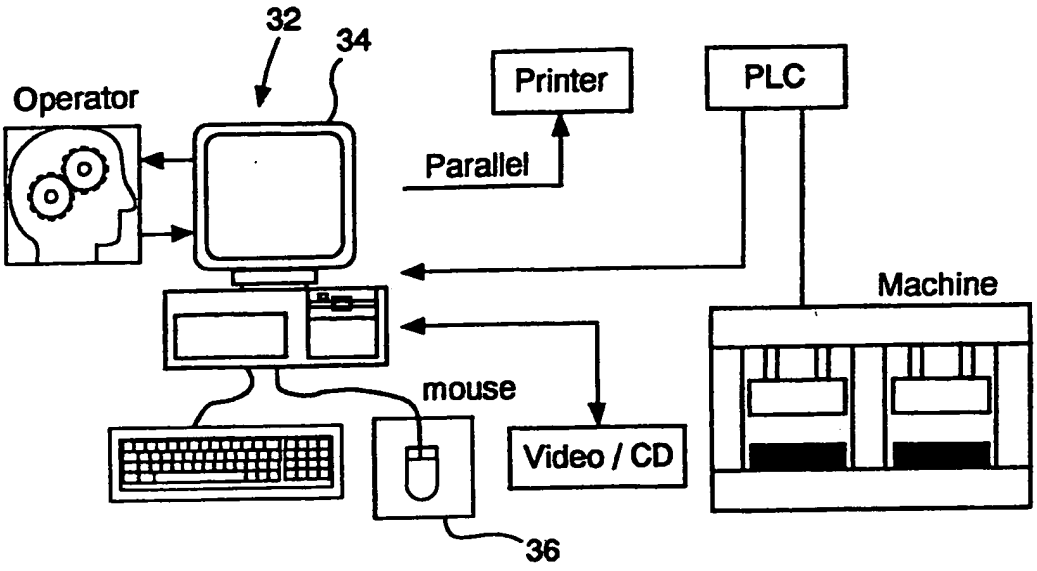
32
34
Operator
Printer
PLC
Parallel
Machine
mouse
Video / CD
36

Fig. 5

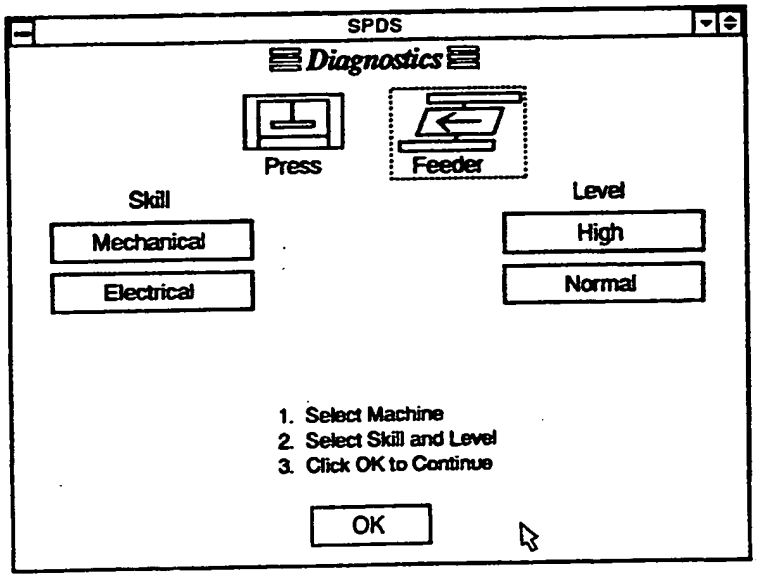
SPDS
Diagnostics
Press
Feeder
Skill
Mechanical
Electrical
Level
High
Normal
1. Select Machine
2. Select Skill and Level
3. Click OK to Continue
OK

Fig. 6

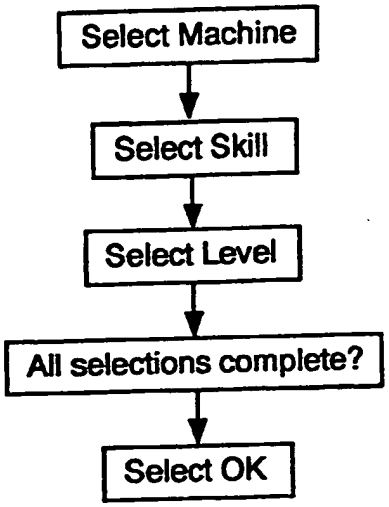
Select Machine
Select Skill
Select Level
All selections complete?
Select OK

Fig. 7

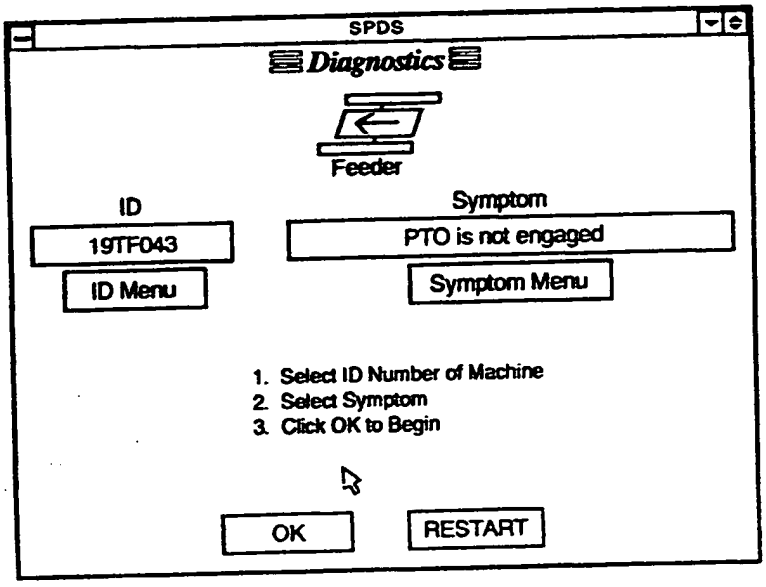
SPDS
Diagnostics
Feeder
ID
19TF043
ID Menu
Symptom
PTO is not engaged
Symptom Menu
1. Select ID Number of Machine
2. Select Symptom
3. Click OK to Begin
OK
RESTART

Fig. 8

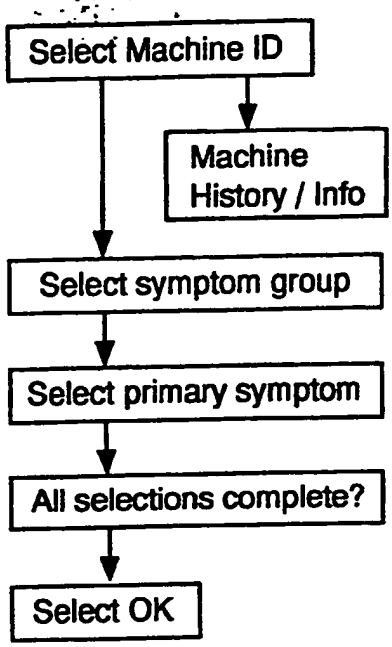
Select Machine ID
Machine History / Info
Select symptom group
Select primary symptom
All selections complete?
Select OK

Fig. 9

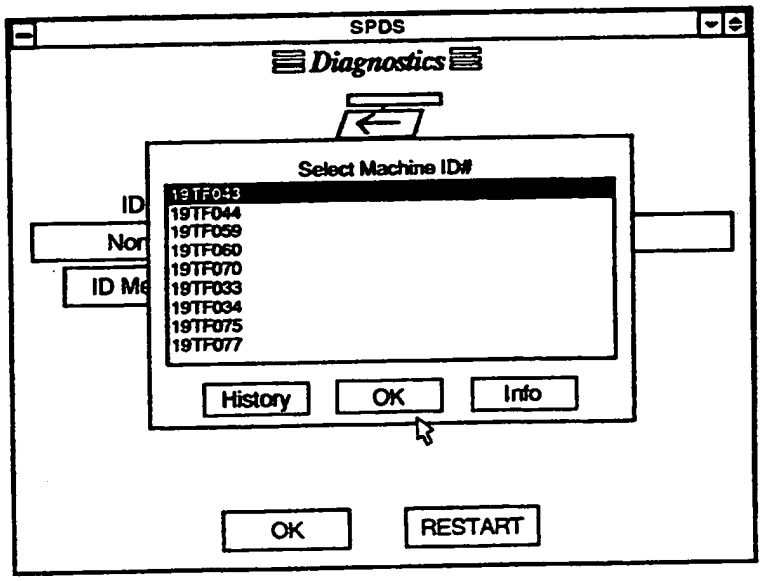
SPDS
Diagnostics
Select Machine ID#
19TF043
19TF044
19TF059
19TF060
19TF070
19TF033
19TF034
19TF075
19TF077
History
OK
Info
OK
RESTART

Fig. 10

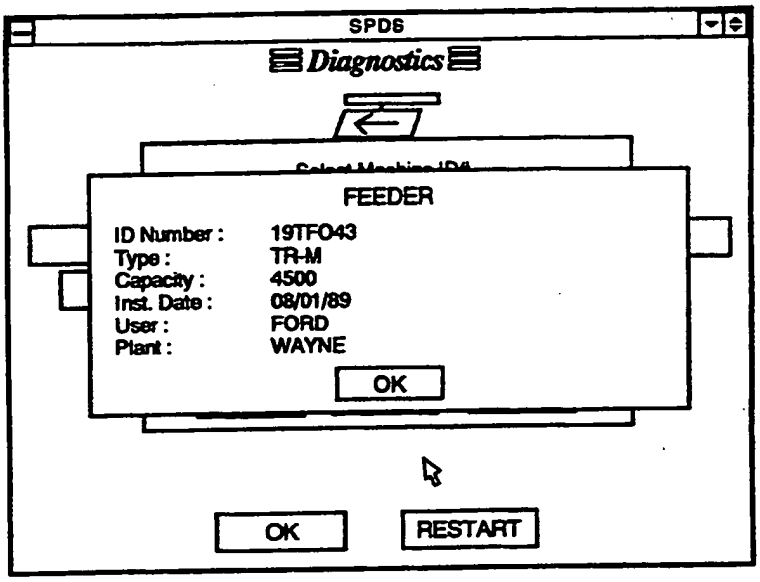
SPD6
Diagnostics
FEEDER
ID Number : 19TFO43
Type : TR-M
Capacity : 4500
Inst. Date : 08/01/89
User : FORD
Plant : WAYNE
OK
OK
RESTART

Fig. 11

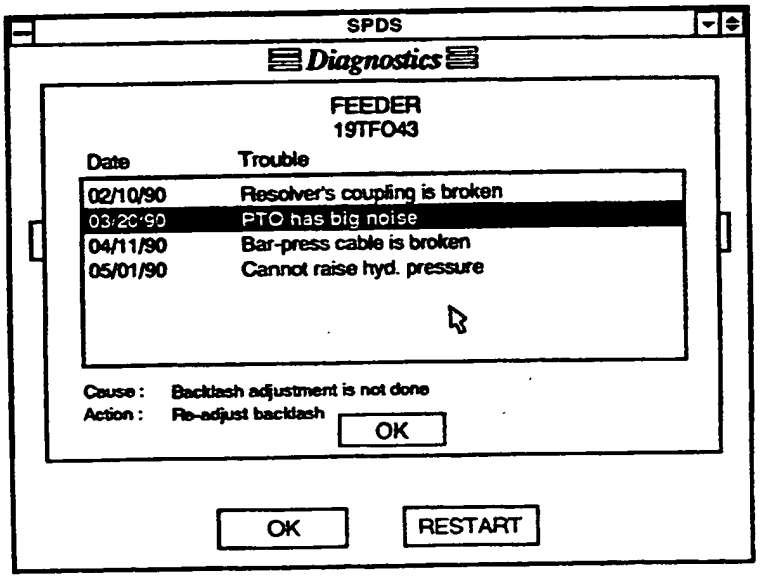
SPDS
Diagnostics
FEEDER
19TFO43
Date
Trouble
02/10/90 Resolver's coupling is broken
03/20/90 PTO has big noise
04/11/90 Bar-press cable is broken
05/01/90 Cannot raise hyd. pressure
Cause : Backlash adjustment is not done
Action : Re-adjust backlash
OK
OK
RESTART

Fig. 12

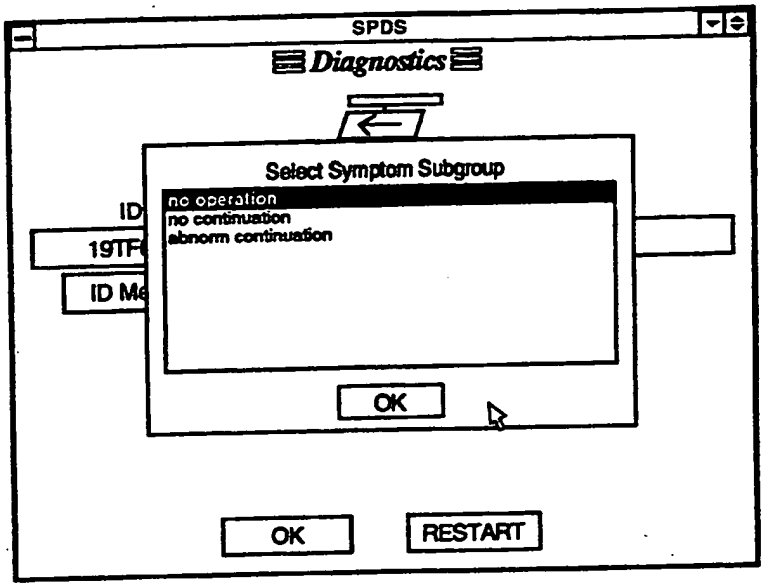
SPDS
Diagnostics
Select Symptom Subgroup
no operation
no continuation
abnorm continuation
OK
OK
RESTART

Fig. 13

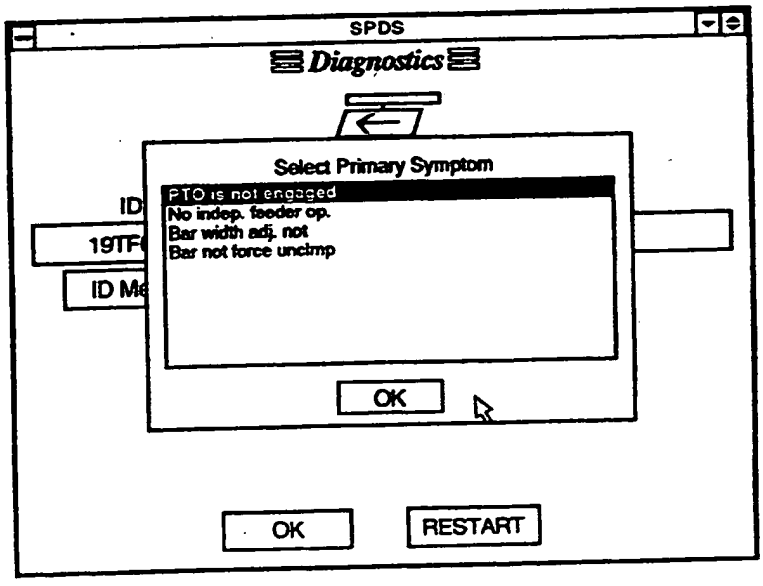
SPDS
Diagnostics
Select Primary Symptom
PTO is not engaged
No indep. feeder op.
Bar width adj. not
Bar not force unclmp
OK
OK
RESTART

Fig. 14

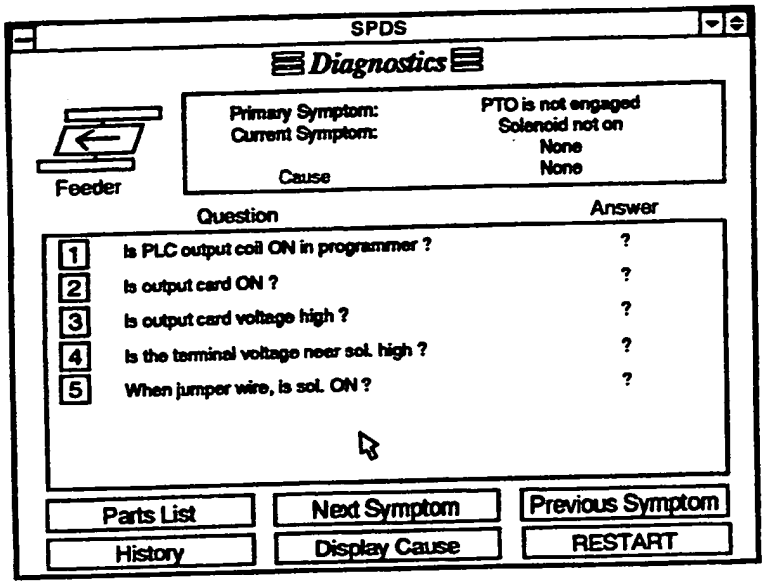
SPDS
Diagnostics
Feeder
Primary Symptom:
Current Symptom:
Cause
PTO is not engaged
Solenoid not on
None
None
Question
Answer
1 Is PLC output coil ON in programmer ? ?
2 Is output card ON ? ?
3 Is output card voltage high ? ?
4 Is the terminal voltage near sol. high ? ?
5 When jumper wire, is sol. ON ? ?
Parts List
Next Symptom
Previous Symptom
History
Display Cause
RESTART

Fig. 15

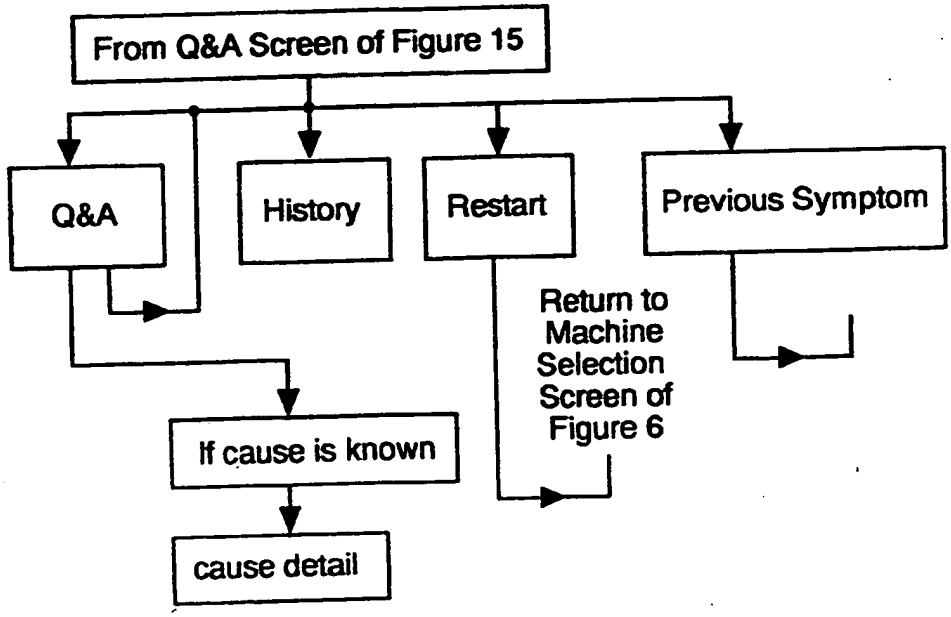
From Q&A Screen of Figure 15
Q&A
History
Restart
Previous Symptom
Return to Machine Selection Screen of Figure 6
If cause is known
cause detail

Fig. 16

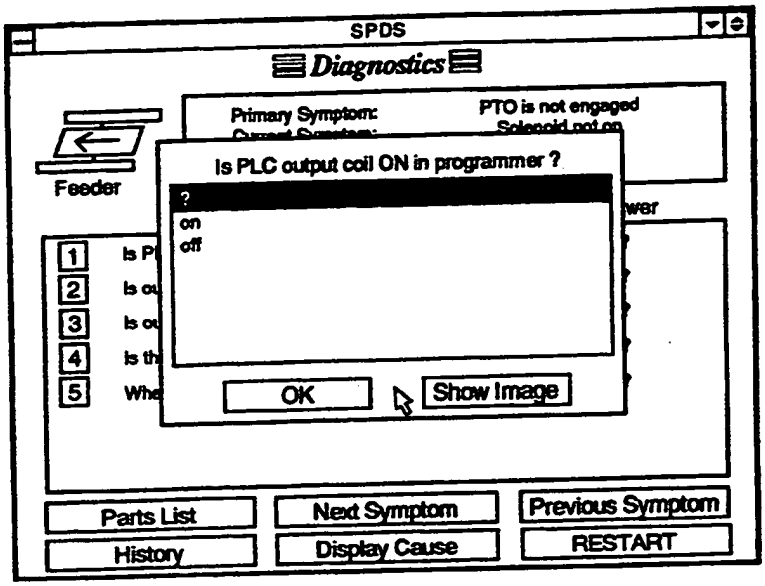
SPDS
Diagnostics
Primary Symptom:
PTO is not engaged
Feeder
Is PLC output coil ON in programmer ?
?
on
off
OK
Show Image
Parts List
Next Symptom
Previous Symptom
History
Display Cause
RESTART

Fig. 17

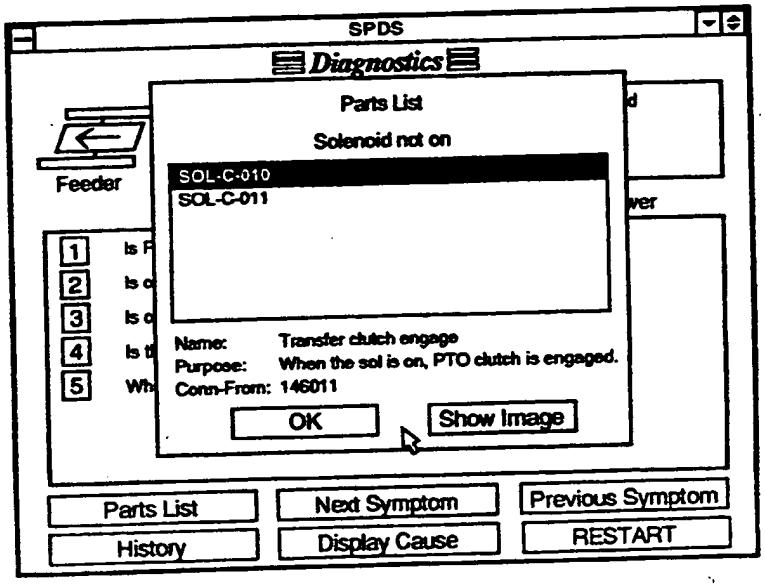
SPDS
Diagnostics
Parts List
Solenoid not on
Feeder
SOL-C-010
SOL-C-011
Name: Transfer clutch engage
Purpose: When the sol is on, PTO clutch is engaged.
Conn-From: 146011
OK
Show Image
Parts List
Next Symptom
Previous Symptom
History
Display Cause
RESTART

Fig. 18

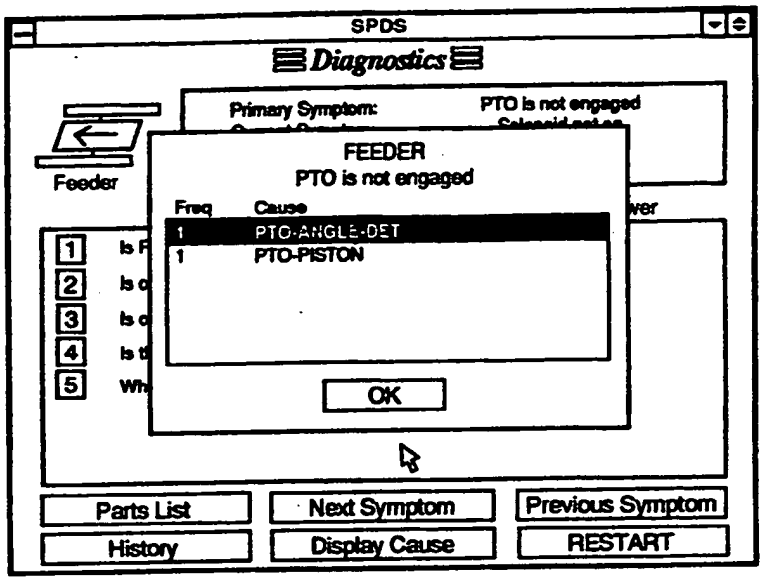
SPDS
Diagnostics
Primary Symptom:
PTO is not engaged
Feeder
FEEDER
PTO is not engaged
Freq
Cause
1
PTO-ANGLE-DET
1
PTO-PISTON
OK
1
2
3
4
5
Parts List
Next Symptom
Previous Symptom
History
Display Cause
RESTART

Fig. 19

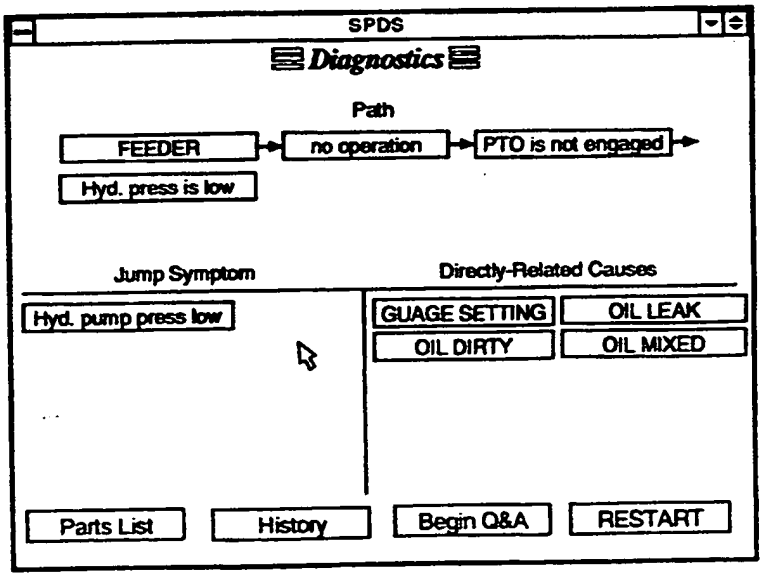
SPDS
Diagnostics
Path
FEEDER
no operation
PTO is not engaged
Hyd. press is low
Jump Symptom
Directly-Related Causes
Hyd. pump press low
GUAGE SETTING
OIL LEAK
OIL DIRTY
OIL MIXED
Parts List
History
Begin Q&A
RESTART

Fig. 20

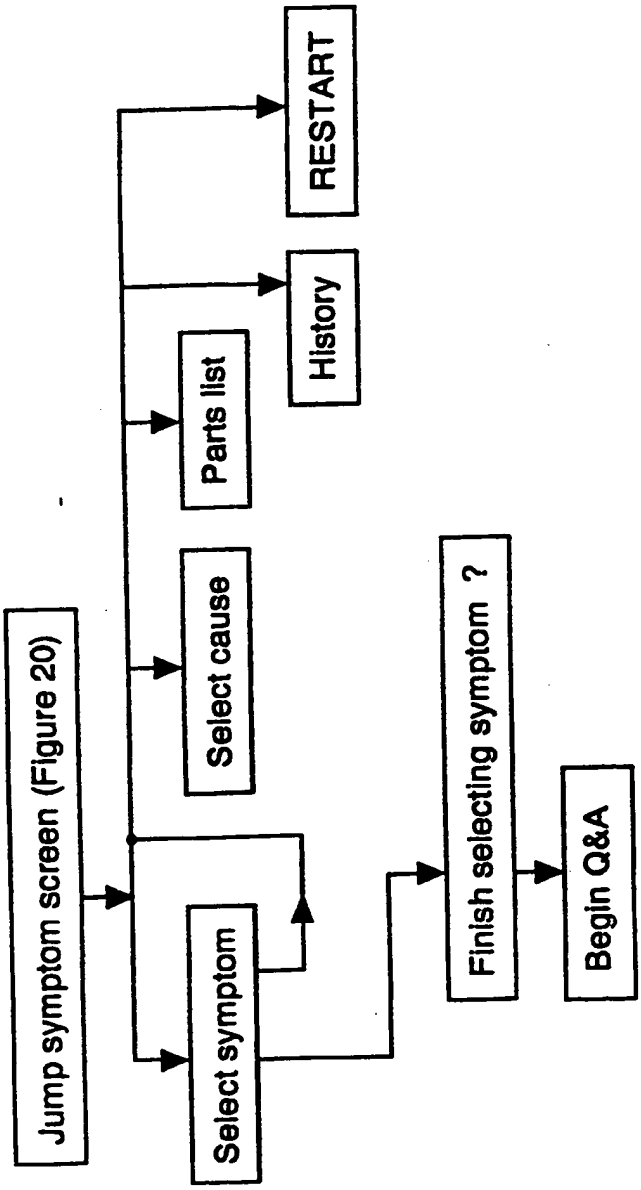
Jump symptom screen (Figure 20)
Select symptom
Select cause
Parts list
History
RESTART
Finish selecting symptom ?
Begin Q&A

Fig. 21

METHOD AND SYSTEM FOR DIAGNOSING MACHINES

This invention relates to diagnostic methods and systems and, in particular, to diagnostic methods and systems including expert systems wherein application knowledge and support information is physically separated from the expert system.

Reference is made to an application entitled "Method And System For Processing And Presenting On-Line, Multimedia Information In A Tree Structure" filed on the same day as this application, having the same assignee and which is hereby expressly incorporated in its entirety by reference.

Conventional expert systems architectures, as illustrated in Figure 1, imbed the application knowledge and support information within the expert system. This is adequate for a one-of-a-kind or simple applications, but restricts the reusability of common software components (i.e. user interface, expert shell rules) for other similar applications.

The U.S. patent to Hardy et al. (4,648,044) discloses a knowledge engineering tool for building a knowledge or expert system. The knowledge system includes a knowledge base in a language expressing facts, rules, and meta-facts for specifying how the rules are to be applied to solve a specific problem. Variables are used in the rules for universal applicability, however, the variables only make a particular rule partially dynamic.

The article entitled "Generic Expert System For Equipment Fault Diagnosis"; K. Wescourt, C. Powell, C. Pickering and D. Whitehead, published by the IEEE and denoted by CH 2331 - 7/86/0000/0489 also discusses the use of variables in rules.

The article entitled "Portable Knowledge-based Diagnostic and Maintenance System"; J. Darvish and N. Olson, published in 1989 at SPIE, Vol. 1095 Applications of Artificial Intelligence, V 11, pp. 357-59 discloses generic software tools and the usage of support drawings within an expert system.

The article entitled "A Diagnostic Aid To Pulp Production"; A. Kowalski and J. Lebensold, published in 1989 at SPIE, Vol. 1095 Applications of Artificial Intelligence, V 11, pp. 858-66 discloses databases which are used to store facts about a diagnostic session. The database is not used to store knowledge or rule contents. This article discloses an example of an expert system interfacing to a relational database.

The article entitled "The Design And Implementation Of A Relation Materials Property Database"; J.S. Colton, Engineering With Computers, Vol. 4, pp. 87-99 (1988) discloses expert system software which uses a relational database to store and retrieve materials property information.

The U.S. patent to Tou et al. (4,930,071) discloses a method for integrating a knowledge-based system with an arbitrary database system.

The U.S. patent to Bajpai et al. (4,985,857) discloses a method and apparatus for diagnosing machines. The patent teaches the use of an expert system for diagnosing faults of machines. The system includes a machine information database and a sensory input database which store data that are to be utilized by the expert system.

The U.S. patent to Kondo (5,021,992) discloses a method of translating data from a knowledge base to a database.

Other knowledge-base system are disclosed in the U.S. patents to Thompson et al. (4,649,515) and Erman et al. (4,658,370).

An object of the present invention is to provide a method and system for diagnosing machines using a computer system having an expert system wherein a knowledge set is physically separate from the expert system.

Another object of the present invention is to provide a method and system for diagnosing machines using a computer system having an expert system and a physically separate knowledge set so that the architecture is modular to allow for different relational database files.

Still a further object of the present invention is to provide a method and system for diagnosing machines using a computer system having an expert system which uses generic rules and a physically separate knowledge set.

In carrying out the above objects and other objects of the invention, an automated method of diagnosing a fault on a machine having a plurality of components using a computer system, having an expert system and a knowledge set is provided. The method includes the step of providing a database separate from the expert system for storing the knowledge set. The knowledge set includes a means for denoting rule information that can be processed by the expert system. The method also includes the steps of receiving an initial command, and dynamically retrieving the rule information from the database in response to the initial command. The expert system is utilized to process the rule information to identify the fault. In this way, the expert system is data driven.

Preferably, the knowledge set includes specific rule information and the database is a relational database.

Also provided for carrying out the above objects and other objects of the present invention is a system for carrying out each of the above method steps.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic block diagram of a conventional expert system architecture;

Figure 2 is a schematic block diagram of a data driven architecture of the present invention;

Figure 3 is another schematic diagram of the system architecture of the present invention;

Figure 4 is a schematic block diagram which demonstrates generic rules of the system;

Figure 5 is a schematic view of a hardware configuration of the system;

Figure 6 is a schematic view of a machine selection screen;

Figure 7 is a block diagram chart illustrating information flow for the screen of Figure 6;

Figure 8 is a schematic view of a symptom screen;

Figure 9 is a block diagram chart illustrating information flow for the screen of Figure 8;

Figure 10 is a schematic view of a machine ID select screen;

Figure 11 is a schematic view of a machine ID information screen;

Figure 12 is a schematic view of a machine ID history screen;

Figure 13 is a schematic view of a symptom sub-group selection screen;

Figure 14 is a schematic view of a primary symptom selection screen;

Figure 15 is a schematic view of a question and answer screen;

Figure 16 is a block diagram chart illustrating information flow for the screen of Figure 15;

Figure 17 is a schematic view of an answer selection screen;

Figure 18 is a schematic view of a part list screen;

Figure 19 is a schematic view of a diagnostic history screen;

Figure 20 is a schematic view of a jump symptom screen; and

Figure 21 is a block diagram chart illustrating information flow for the screen of Figure 20.

There is illustrated in Figure 2 a data driven architecture wherein the expert system of the present invention is physically separated from the application knowledge and support information of the expert system (i.e. the knowledge set of the expert system). Thus, the knowledge set drives the application or otherwise stated "the system is data driven". With this data driven architecture, the expert system portion is reusable by supplying different knowledge sets. To further enhance this concept, the development of generic rules is provided. This

allows rules in the expert system to be reusable and the ability to obtain rule content information from the knowledge set as described hereinbelow in detail and with reference to its application to a diagnostic system for a machine tool such as a stamping press as is more fully disclosed in the above-noted application.

Stamping Press Diagnostic System Application

The stamping press diagnostic system (SPDS) is based on the data driven architecture of Figure 3 and uses a relational database 20 to store the knowledge set information.

The expert system preferably contains the following components:

Clips 22, a C-language integrated production system expert shell developed by NASA, for the inference engine and generic rule definitions. However, it is to be understood that other expert shells can be utilized in carrying out the invention;

A menu-driven user interface 24;

I/O drivers 26 to communicate with PLCs of the stamping press; and

Multimedia 28 support and other required utilities.

The database 20 contains press-related (i.e. multimedia) and diagnostic rule information required by the expert system to perform its operations. The DBASE III+ database package is preferably used to support the database portion of the software. The expert system and the database are tied together but are not incorporated into each other.

General Operation Of System

Upon entering a press failure mode, either the operator or the expert system, based on PLC information, starts the diagnostic process. The necessary knowledge and rules are extracted from the database 20 and acted upon. Until the cause of the problem is identified, the system requests

additional symptom or status information from the operator and/or the PLC system. The PLC system fault information greatly enhances the system by minimizing the diagnostic search - thus reducing unnecessary processing and user dialogue.

When the failure mechanism or fault has been identified, then the operator is instructed on the appropriate repair procedure(s).

To further assist in the diagnostic process and visual conception of the repair procedures multimedia utilities 28 (text, full motion & still video images, schematics, drawings, and sound) are utilized as described in the above application.

The knowledge base information is generated through a separate independent user development interface. This database front end is user friendly and tailored to force a sound knowledge representation of the system.

Generic Rules

Conventional expert systems applications incorporate sometimes hundreds of rules, with a significant amount of similarity. To minimize redundancy and force reusability, the SPDS design creates a few generic rules that satisfies the full application. What makes the generic rule distinct is its contents, which is dynamically retrieved from the database.

With reference to Figure 4, to demonstrate this concept, the operator first tells the system which press device (?device = PTO) is faulty and what the primary symptom (?symptom = hot) is. This information is placed into the left-hand side of the rule,

```
if  (device ?device)
    (symptom ?sym)
```

Now for that rule to fire, a database column search is executed to see if there is a match on the device = PTO and symptom = hot. The system finds a match and returns the cause, "no-lub", to the right-hand of the rule. The rule

then processes and displays this information to the operator.

In Figure 4, there are four device/symptom possibilities as shown in the database, which work with the demonstrated generic rule. But, in actual applications, the number of device/symptom possibilities is unlimited.

Generic rules can perform many functions. For example, they can provide navigation through the database information, execute action, or request new information. Also, many generic rules can fire with the same left-hand side rule information.

Detailed Description Of System

In general, the goal of the stamping press diagnostic system (SPDS) is to determine the cause of a machine failure. Each cause is expected to express itself in the form of symptoms that can be identified by performing tests on the machine. SPDS classifies symptoms into two categories: primary and refined.

Primary systems are problems that would be obvious to any operator. Refined symptoms are problems that are only apparent after testing the machine. For example, an oil leak lowers hydraulic pressure which in turn keeps the PTO from engaging. The operator would be able to see the primary symptom, the fact that the PTO did not engage. Testing would reveal a refined symptom, the low hydraulic pressure. Further testing would reveal the cause of the failure, the oil leak.

Each symptom has a group of tests associated with it. These tests are presented in the form of multiple-choice questions. As the operator conducts the specified tests and answers the system's questions presented on screens as described in detail hereinbelow, more information is learned about the situation. Eventually, the system is able to identify either a refined symptom or the cause of the failure. The operator can then either answer a new set of questions or view the repair procedure.

Referring to Figure 5, there is illustrated the preferred hardware requirements of the system. The system includes:

A computer 32 such as an IBM® AT/PS-2 compatible 286 or 386 or 486 machine;

A memory such as 640Kb of RAM and 3Mb of extended RAM;

A storage such as a 20Mb Hard disk (minimum);

monitor 34 such as a VGA color display (640*480);

OS/Shell such as Microsoft® Window 3.0 and Dos 3.3 (minimum); and

A mouse 36 such as a serial or bus mouse (2 button type).

Basic Mouse Movements

There are three basic mouse techniques that one can use with this application: pointing, clicking, and selecting.

Pointing

The mouse 36 controls a cursor, or "pointer" on the screen. One moves the pointer on the screen by moving the mouse 36 over a desk top in the direction one wants the pointer to move. One can use the mouse 36 to move the pointer to a particular location on the screen or point at something on the screen.

Clicking and Selecting

Clicking means to press and then quickly release a mouse button. In this application, it is always the left button that is used for clicking. by pointing to something on the screen and then clicking the left mouse button, one has selected what is underneath the onscreen pointer.

SPDS Start Up

Step 1:Power on the computer.
Step 2:To run SPDS: at the c:> prompt enter WIN SPDS and hit the ENTER key.
Step 3:After a short period of time the initial SPDS screen appears. Proceed as described hereinbelow.

Exiting SPDS

Step 1:Click on the box in the upper left corner of the screen. This will provide a pop up window that provides a list of options. Select "Close" option.
Step 2:Click on the Program Manager icon in the lower left corner of the screen. Select "Close" option in the pop up menu that appears.
Step 3:A verification window pops up, select save configuration and then click on the "OK" button. This returns the system to the c:> prompt.

Referring to Figure 6, there is an initial screen for diagnostics. The defective machine, operator's skill and skill level are set here. Referring to Figures 6 and 7, there is shown the required information flow for the machine selection screen. First select the defective machine, then the operator skill and finally the operator skill level.

1. Machine Selection - Machine selection icons are located at the top of the screen. Select the icon of the defective machine. The selected machine icon is highlighted.

2. Skill Selection - Select a skill box. The selected skill box is then double-bordered.

3. Level Selection - Select a skill level box. The selected skill box is also double-bordered.

A symptom screen, as shown in Figure 8, allows for the operator to enter the machine ID number and select the primary machine symptom. Figure 9 shows the required information flow for the symptom screens. First, select the

machine ID, then the symptom group followed by the primary symptom. When all of this information has been designated, click on the "OK" button to exit and go to the next screen. Also when selecting the machine ID number additional information about the machine can be viewed.

Machine ID Selection

Click the "ID Menu" button from the screen of Figure 10. This activates the machine ID pop up window. All of the related machine IDs for this type of particular machine are displayed. The ID of the defective machine is selected, followed by clicking on the "OK" button. This returns one to the main symptom screen and the newly chosen machine ID displayed in the ID menu display box. If additional machine information is required, the "History" or "Info" buttons are selected.

Machine ID Information

Click on the "Info" button from the Machine ID Select Screen of Figure 11. This brings up information about the particular machine. Information displayed indicates the machine ID, the type of machine to be referenced, its capacity, when it was installed in the plant and what company and at what plant this particular machine is located. To return to the previous screen, click on the "OK" button.

Machine ID History

Click on the "History" button from the Machine ID Select Screen of Figure 12. This brings up all previous related machine problems, as shown above. The date and the basic description of the problem are displayed. Selecting a line item will display the cause behind the problem and action taken, which will be shown in the lower part of the pop up window. To return to the previous screen of Figure

11, click on the "OK" button.

Symptom Group Selection

Click on the "Symptom Menu" button from the Symptom Screen of Figure 13. This displays a symptom subgroup list. Select the symptom group that is related to the current fault. Then click on the "OK" button to exit this screen and enter the Primary Symptom selection screen.

Primary Symptom Selection

After exiting the Symptom Group Selection Screen of Figure 13, a new pop up window will be presented, a shown in Figure 14. This new window will list all the primary symptoms for the specific symptom group. Select the primary symptom and then click on the "OK" button to exit and return to the Symptom Screen of Figure 8.

Once the machine and primary symptom are defined, the associated question and answer sets are displayed, as shown in Figure 15. By selecting and answering the correct questions pertaining to the cause, one stimulates a new question set (next symptom) or provides the CAUSE. Not all questions have to be answered to determine a cause. If the wrong answer or question were selected at any time during the question dialogue, the operator can backup to the previous symptom. Figure 16 shows the required information flow for the Question & Answer screens.

Question Selection

To start the question dialogue, a list of questions is shown, as illustrated in Figure 15. Each question is to be carefully reviewed to answer the question(s) that most likely pertain to the problem. To answer a question click on the question box just to the left of the question. This causes the answer pop up window to be displayed. All answered questions display their current answer on the right

side of the Question/Answer box.

Every time a question is answered or an answer is changed, the system searches for new symptoms and/or causes. If there is a new symptom, it is displayed in the top box under Next Symptom. To jump to the next symptom, select the "Next Symptom" switch. If there is a cause determined, it is displayed in the top box under Cause. To display more detail information about the cause, the "Display Cause" switch is selected. If there is no Next Symptom or Cause displayed in the top box, selecting any of two switches, "Next Symptom" or "Display Cause" switches, generates an error message.

If a question appeared in a previous group and was answered, that answer is displayed in (gray) color when a set of questions first comes up. This answer cannot be changed unless one backs up to original location where the question came from.

Answer Selection

In the answer box, as shown in Figure 17, there are several options that one can investigate and execute. To answer the question, select the correct answer. This causes the line with that answer on it to be highlighted. To exit the window and secure one's answer, click on the "OK" button. If additional information is required, click on the "Show Image" button, this shows a graphic image relative to the question. Not all questions have an associated graphics image, therefore a NO IMAGE message may be encountered.

Parts List

While in the Question & Answer Screen of Figure 15, the list of parts or components which may be causing the current symptom can be listed out. By clicking on the "Parts List" button, the parts list pop up window is displayed, as shown in Figure 18. Within the window, the machine and current symptom are displayed at the top of the

window. The part name, part purpose and connecting device are displayed in the lower portion of the window.

To retrieve an image to a specific part(s), one selects the part line item and then selects the "Show Image" switch. This displays the related graphic image. If there is no image for the specific part, the message, "No image available for this part" is displayed.

Diagnostic History

Historic information surrounding the primary symptom of Figure 15 can be called up. Click on the "History" button from the Question & Answer Screen of Figure 15 and the history pop up window will display the primary symptom, final causes and their frequencies. An example of this particular screen is shown in Figure 19.

Other Questions & Answer Button Definitions

Previous Symptom: The system can be moved back to the previous symptom by clicking on the "Previous Symptom" button. The questions related to the previous symptom are displayed.

Restart: To restart the whole diagnostic procedure, click on the "Restart" button. This returns one to the beginning screen. When selecting this option, all the information deduced from the previous questions is lost.

The jump symptom of Figure 20 is designed exclusively for a high level operator. In the initial screen selecting the high skill level signals the system to bypass the standard Question and Answer screens. This helps an experienced operator bypass early questions when he or she already has a general idea what is wrong with the system. As the operator selects the symptoms that describe the fault, a graphical symptom path is displayed at the top of the screen. Anytime during this session one can start the standard Question and Answer session to narrow down the cause. Figure 21 shows the information flow for the jump

symptom screens.

Select Symptom

Once the primary symptom is defined, the connected jump symptoms are displayed as shown in Figure 20. To select the next symptom that best fits the current fault, one clicks on one of the symptom boxes under the Jump Symptom column. The new symptom is attached to the graphical symptom path at the top of the screen. After each symptom selection, a new set of symptoms is displayed. To return to a previous symptom, click on that symptom block at the top of the screen. For example, if A -> B -> C symptoms are shown on the upper half of the screen, and by selecting B, the system releases C and the screen changes as follows: A -> B.

Select Cause

A list of possible directly related causes are displayed on the right side of the screen. By selecting one of the causes, additional detailed information in the form of an image can be viewed.

Other Jump Symptom Button Definitions

Begin Q&A: Clicking on the "Begin Q&A" button will start a question and answer session from the current symptom. Further definition of this procedure is in the Question & Answer section.

Parts List: Same definition as described in the Question & Answer section.

History: Same definition as described in the Question & Answer section.

Restart: Same definition as described in the Question & Answer section.

The method and system of the invention have been described above for diagnosing faults in a machine such as a

stamping press. However, it is to be understood that the present invention could be utilized for a wide variety of diagnostic systems to make such systems modular and substantially reusable. Also, the invention lowers machine downtime.

CLAIMS

1. An automated method of diagnosing a fault on a machine having a plurality of components using a computer system having an expert system and a knowledge set, the method comprising the steps of:

providing a database separate from the expert system for storing the knowledge set, the knowledge set including:

means for denoting rule information that can be processed by the expert system;

receiving an initial command;

dynamically retrieving the rule information from the database in response to the initial command; and

utilizing the expert system to process the rule information to identify the fault whereby the expert system is data driven.

2. An automated method for diagnosing a fault on a machine having a plurality of components using a computer system having input means, output means, an expert system and a knowledge set, the method comprising the steps of:

providing a database separate from the expert system for storing the knowledge set, the knowledge set including:

means for denoting diagnostic information that can be presented by said output means to a user of the system; and

means for denoting rule information that can be processed by the expert system;

receiving an initial command;

delivering a portion of the diagnostic information to the output means to be presented thereby to the user of the system in response to the initial command;

receiving a user command related to the portion of the diagnostic information from the input means;

dynamically retrieving the rule information from the database in response to the user command; and

utilizing the expert system to process the rule information to identify the fault whereby the expert system is data driven.

3. a method as claimed in claim 1 or 2, wherein the rule information is generic rule information.

4. A method as claimed in claim 1 or 2, wherein the database is a relational database.

5. A method as claimed in claim 1 or 2, wherein the database is an object oriented database.

6. A method as claimed in claim 1 or 2,wherein the computer system is adapted to be coupled to at least one controller of the machine and wherein the initial command is based on controller information of the at least one controller.

7. A method as claimed in claim 1 or 2,wherein the initial command is based on a user driven input signal.

8. A system for diagnosing a fault on a machine having a plurality of components in a computer system including an expert system and a knowledge set, the system comprising:

a database separate from the expert system for storing the knowledge set, the knowledge set including:

means for denoting rule information that can be processed by the expert system; and

means for receiving an initial command, the computer system dynamically retrieving the rule information from the database in response to the user command and the expert system processing the rule information to identify the fault of the machine whereby the expert system is data driven.

9. A system for diagnosing a fault on a machine having a plurality of components in a computer system having input means, output means, an expert system and a knowledge set, the system comprising:

a database separate from the expert system for storing the knowledge set, the knowledge set including:

means for denoting diagnostic information that can be

presented by the output means to a user of the system; and

means for denoting rule information that could be processed by the expert system; and

means for receiving an initial command, the expert system delivering a portion of the diagnostic information to the output means to be presented thereby to the user of the system in response to the initial command and the expert system receiving a user command related to the portion of the diagnostic information from the input means, the expert system dynamically retrieving the rule information from the database in response to the user command and the expert system processing the rule information to identify the fault whereby the expert system is data driven.

10. A system as claimed in claim 8 or 9, wherein the rule information is generic information.

11. A system as claimed in claim 8 or 9, wherein the database is a relational database.

12. A system as claimed in claim 8 or 9,wherein the machine is controlled by at least one controller and wherein the computer system is adapted to be coupled to the at least one controller and wherein the initial command is based on controller information of the at least one controller.

13. A system as claimed in claim 8 or 9, wherein the initial command is based on a user driven input signal.

14. A system as claimed in claim 8 or 9, wherein the database is an object oriented database.